PATENT ABSTRACTS OF JAPAN

(54) VARIABLE LENGTH CODER AND DECODER

(57)Abstract:

PURPOSE: To improve the coding efficiency by dividing a DCT coefficient area
in response to a characteristic of a DCT coefficient distribution of a signal
to be processed so as to allocate a code word by optimum 2-dimension Huffman
coding and to apply variable length coding.

CONSTITUTION: A scanning converter 12 scans a data string of N×N picture
element blocks to form a linear data string from a low frequency to a high
frequency in a DCT transformation coefficient area. A changeover circuit 13
and a coefficient count circuit 20 introduce the linear data string to zero
run length/non-zero coefficient detection sections 14-16 corresponding to each
area in a form of dividing the block to plural areas. Then the respective zero
run length/non-zero coefficient detection sections 14-16 output a signal to 2-
dimensional Huffman code word table reference means 17-19 preparing a Huffman
word table suitable for the characteristic of each output.

CLAIMS

[Claim(s)]

[Claim 1]A device which divides a picture signal per NxN picture element
blockand carries out variable length coding of DCT and the data which carried

out quantization processing using two-dimensional Huffman codingcomprising:
A scanning conversion means which scans a data row of a block of NxN and is made into a one-dimensional data row from low-pass [of a DCT transformation coefficient field] to a high region.
A means by which an output of at least one the zero run length / a non-zero coefficient detection means to compute combination of a zero run length and a non-zero coefficient outputs independently a zero run length of each region divisionand a non-zero coefficient coefficient one by one to said one-dimensional data row in a form divided into two or more DCT transformation coefficient fields.
Two or more two-dimensional Huffman coding word table reference means by which combination of said zero run length of each region division and a non-zero coefficient is inputtedrespectivelyand assigns a two-dimensional Huffman coding word to the input.

[Claim 2]A device characterized by comprising the following by which variable length coding was carried out using two-dimensional Huffman coding and which divides a picture signal per NxN picture element blockand decrypts DCT and data which carried out quantization processing.
A means for output variable length data of two or more two-dimensional Huffman coding word table reference means to be inputted one by oneand to separate each variable length data.
Two or more two-dimensional Huffman decoding table reference means which each output of said separating mechanism is introduced and are returned to combination of a zero run length and a non-zero coefficientrespectively.
Two or more zero run length / non-zero coefficient decoding means which are changed into the 1-dimensional each data row of a DCT transformation coefficient field outputted in an area dividing means of claim 1 to each output of two or more of said two-dimensional Huffman decoding table reference means
A quantization data rearrangement means to carry out multiplex [of each output of two or more of said zero run length / non-zero coefficient decoding means]and to return to a one-dimensional data row conversion factor sequenceand to reconvert this coefficient sequence to a two-dimensional data row.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application]This invention relates to variable length coding and the decoding system which are adopted with the highly efficient coding system of the imageetc.
[0002]
[Description of the Prior Art]A variable-length-coding method is held as one of the effective techniques of making the transmission rate of image data small. When this method binary-code-izes the information series of a quantization levela quantization patternetc. it shortens average code length by assigning long code length's numerals to the large level of the probability of occurrence for short code length's numerals at a small level according to the probability of occurrence of that quantization level.
[0003]In the variable-length-coding method of image datathe two-dimensional Huffman coding system is used welland it is adopted by H.261 advice of CCITTMPEGetc. HereH.261 advice is hereafter explained to an example.
[0004]The block diagram of the coding processing including variable length coding is shown in drawing 9 (A). Split application of the inputted image is carried out every picture element block of 8x8. Two-dimensional DCT (discrete cosine transform) processing is performed to a picture element block in the discrete cosine transform (DCT) circuit 91and it obtains the conversion factor of 8x8. It is quantized with the quantizer 92and with the variable-length-coding machine 93using a two-dimensional Huffman coding systemvariable length coding of these conversion factors is carried outand they are outputted.
[0005]Herethe variable-length-coding machine using two-dimensional Huffman coding is explained to details to a slight degree with reference to drawing 9 (B). In the scan converter 931the two-dimensional DCT coefficient of 8xquantized 8 (piece) is scanned in an order as shown in drawing 11 (A)and is changed into 64 one-dimensional series. Howeverthe position of one in a figure expresses the direct-current (DC) ingredient of the DCT transformation fieldit is shown that such a horizontal DCT transformation field that it goes rightward from this position turns into a high regionand it is shown that the coefficient field of vertical DCT turns into a high regionso that it goes downward. Thereforein the example of drawing 11 (A)a zigzag scan will be carried out from low-pass [of a DCT transformation field] to a high region in an oblique direction at order. To this 64 one-dimensional seriesin a zero run length / non-zero coefficient primary detecting element 932. As shown in drawing 11 (B)the zero run length (length which a zero coefficient follows) (L) before the non-zero coefficient amplitude (M) and it except the DC component (ingredient of the beginning of a one-dimensional series) of a DCT coefficient is combined in order. And to such combination (LM)in the two-

dimensional Huffman coding table reference part 934a variable length code is assigned respectively and outputted.

[0006]Herethe table of the two-dimensional Huffman coding word is created as follows. that isit asks for the size of those probability of occurrence beforehand by making a set of the combination (LM) of the zero run length in a total of 64 DCT fieldsand non-zero coefficient amplitude into an information source sequenceand each symbolic language is assigned by a Huffman encoding method. An example of this two-dimensional Huffman coding word table is shown in drawing 12. Since code length becomes longthe combination which is not included in this code word table is coded by fixed length.

[0007]Nextthe block diagram of decoding processing is shown in drawing 10 (A). The picture signal coded as mentioned above is decrypted and outputted with the variable-length decryption machine 101. And inverse quantization is carried out by the inverse quantization device 102reverse DCT is carried out further in the inverse DCT circuit 103and a picture is reproduced per picture element block of 8x8.

[0008]Herethe variable-length decryption machine 101 of drawing 10 (A) is explained to drawing 10 (B) a little in more detail. The image coded using two-dimensional Huffman coding is returned to the original zero run length L and combination (LM) with the non-zero coefficient amplitude M from a symbolic language by the two-dimensional Huffman decoding table reference part 10a. It returns to 64 quantization coefficient sequences by the zero run length / non-zero coefficient decoding section 10band is changed into the data row before a zigzag scan in the quantization data rearrangement part 10c.

[0009]By the waygenerallypower concentrates distribution of the conversion factor obtained by the picture signal with the application of DCT processing on low-pass [of a conversion area] so that drawing 13 may see. Drawing 13 (A) is an 8x8-pixel original picture blockand the figure (B) is the coefficient after carrying out DCT processing of the original picture block. If power concentrates on low-pass [of a conversion area]since the occurrence frequency of zero coefficient amplitude decreases even if the amplitude of each conversion factor is large and is quantizedon low-passa zero run length will become short. And in a high regioneach conversion factor amplitude becomes small converselyand since the occurrence frequency of zero coefficient amplitude also increasesa zero run length tends to become long.

[0010]for this reasonif the two-dimensional Huffman coding called for from the size of the probability of occurrence of the combination (LM) of the zero run length in all the DCT fields ranging from low-pass [of 8x8=64 (piece) / to a high region] and non-zero coefficient amplitude is usedSince the character of the above-mentioned picture signal is not taken into considerationsufficient encoding efficiency is not acquired.

[0011]

[Problem(s) to be Solved by the Invention]Since variable length coding of the symbolic-language assignment by two-dimensional Huffman encoding is performed and carried outwithout taking into consideration the bias of DCT transformation coefficient distribution of a picture signalthe problem that sufficient encoding efficiency is not acquired exists.

[0012]

[Means for Solving the Problem]In a device which carries out variable length coding of the quantization DCT coefficient of a NxN picture element block using two-dimensional Huffman codingA region dividing part which divides into plurality a DCT coefficient by which the one-dimensional systematization was carried out and to which it is made to output is providedTwo or more zero run length / non-zero coefficient primary detecting elements which compute combination of a zero run length and a non-zero coefficient from each coefficient-of-contingency sequenceand two or more two-dimensional Huffman coding word table reference parts which assign them a two-dimensional Huffman coding word are givenA field multiplex section which carries out the selected output of the symbolic language which was furthermore divided and was called for one by one is provided.

[0013]In a variable length decoding device corresponding to the above-mentioned variable length coding deviceIn the preceding paragraph of a quantization data rearrangement part reconverted to a data row before a zigzag scan. A region dividing part into which divide an inputted symbolic language into like a case of coding equipmentand it is made to input is providedTwo or more two-dimensional Huffman decoding table reference parts which return a division symbolic language to combination of a zero run length and a non-zero coefficientand the zero run length / non-zero coefficient decoding part which returns them to the divided original DCT coefficient sequence are givenA field multiplex section outputted so that a DCT coefficient sequence currently furthermore divided may be chosen one by one and it may return to the original one-dimensional series is provided.

[0014]

[Function]In the region dividing part of a variable length coding devicethe DCT coefficient sequence in which the one-dimensional systematization was carried out by the zigzag scan from low-pass in the high region at order is divided for two or more conversion areas of every which embraced DCT coefficient distribution of the picture signal. The DCT coefficient sequence dividedrespectively is changed into the series of the combination of a zero run length and non-zero coefficient amplitude in each zero run length / non-zero coefficient primary detecting element. In a 2-dimensional each Huffman coding word table reference partthe two-dimensional Huffman coding word

beforehand searched for for every region divisionrespectively is assignedand variable length coding in consideration of the bias of DCT coefficient distribution is performed. In a field multiplex sectiona selected output is carried out one by one so that these divided symbolic languages may be again located in a line with a high region from low-pass [of a DCT coefficient field].

[0015]In the region dividing part of a variable length decoding devicethe inputted symbolic-language sequence is divided and outputted for two or more conversion areas of every which embraced DCT coefficient distribution of the picture signal again. In a 2-dimensional each Huffman decoding table reference partthe symbolic-language sequence dividedrespectively is reconverted at the series of the combination of a zero run length and non-zero coefficient amplitude. In each zero run length / non-zero coefficient decoding partthe series of the above-mentioned combination is reconverted for the one-dimensional series of the DCT coefficient in a region divisionrespectively. In a field multiplex sectionthese one-dimensional series currently divided are again returned to the 64 original one-dimensional series at the order by which the zigzag scan was carried out. By thesethe symbolic language by the two-dimensional Huffman encoding according to DCT coefficient distribution of the picture signal is assignedand variable length coding and decryption are performed.

[0016]

[Example]Hereafterthe example of this invention is described with reference to drawings.

[0017]In this inventionthe quantized DCT coefficient field is divided into two or more fieldsand two-dimensional Huffman encoding is performed. In this casevarious fields to divide are considered. Drawing 8 (a) Various kinds of examples of division are shown in - (d).

[0018]Herewhen a region division is set upit is possible that the original zero run length straddles two or more fields (refer to drawing 7 (a)). In such a casea zero run length is also divided for every region divisionand the method (refer to drawing 7 (b)) of carrying out two-dimensional Huffman encodingand when the zero run length is straddling the region divisionthere is the method (refer to drawing 7 (c)) of incorporating into one of fields and coding.

[0019]The variable length coding device of the 1st example of this invention is shown in drawing 1. In this examplewhen a trichotomy field as shown in drawing 8 (a) as a region division is taken and the original zero run length straddles two or more fields (refer to drawing 7 (a))a zero run length is also divided for every region divisionand the method (refer to drawing 7 (b)) of carrying out two-dimensional Huffman encoding is adopted. In drawing 1DCT and

the signal (the followinga quantization DCT coefficientand the notation) which quantized further input into the picture signal divided into the input edge 11 of the variable length coding device every 8x8 picture element block. This signal scans two-dimensional 8x8 picture element data from the low-pass ingredient side in order (drawing 11 explains) to the high-frequency component side with the scan converter 12and changes it into 64 one-dimensional data rows.

[0020]The data of the quantization DCT coefficient by which the zigzag scan was carried out from low-pass [of the DCT coefficient field] with the scan converter 12 in the high regionIt is divided into the conversion factor field of plurality (for examplethree) which embraced DCT coefficient distribution of the picture signaland from low-pass [the]it switches to a high region in orderand is outputted to the zero run length / non-zero coefficient primary detecting elements 9495and 96 corresponding to the field in the switching circuit 13. That isthe serial coefficient currently outputted from the scan converter 12 is inputted into the coefficient count circuits 20. And whenever the coefficient count circuits 20 count 10 of 64 DCT coefficient data18 piecesand 36 piecesthey are switched to the switching circuit 13 and output a control signal. As a resulta DCT coefficient is divided into 3 of the field A (DCT low-pass)B (DCT mid-range)and C (DCT quantity region) fieldsand becomes ten pieces18 piecesand 36 data rowsrespectively. the time of ten data of the field A -- a zero run length / non-zero primary detecting element 14 -- next18 data of the field B will be outputted to a zero run length / non-zero primary detecting element 15 at the endand 36 data of the field C will be outputted to a zero run length / non-zero primary detecting element 16.

[0021]Variable length coding of the divided DCT coefficient data row is carried out to order from the data of the field A in the zero run length / non-zero coefficient primary detecting elementand the two-dimensional Huffman coding word table reference part corresponding to each field. It is changed into the series of the combination of a zero run length and non-zero coefficient amplitude in a zero run length / non-zero coefficient primary detecting elements 1415and 16. In the corresponding two-dimensional Huffman coding word table reference parts 1718and 19each two-dimensional Huffman coding word in the field ABand C beforehand searched for based on the probability of occurrence of the combination of a zero run length and non-zero coefficient amplitude is assigned.

[0022]For exampleshort numerals shall be assigned to the comparatively big non-zero coefficient in the field Ashort numerals shall be assigned to a comparatively long zero run length in the field Cand the thing of these interim characteristics shall be used for the two-dimensional Huffman coding of each field in the field B.

[0023]. In the case of the 1st above-mentioned exampleas shown in <u>drawing 7</u> (b)remained combining a zero run length and non-zero coefficient amplitude by (A) in the region division. About the zero run length (in this casetwo pieces) over the next field (B). The numerals (temporarily referred to as EOSB (End Of Sub-Block)) which show the end of the combination in a region division shall be transmitted instead of considering two-dimensional Huffman encoding also including theseor transmitting these. As a resultthe coded DCT coefficient sequence is outputted to a high region one by one from low-pass [of a DCT coefficient field].

[0024]Nextthe 2nd example explains the case (<u>drawing 7</u> (c)) where two-dimensional Huffman encoding even of the zero of the last is carried out using the two-dimensional Huffman table of the field where the zero of the beginning of the zero run length over two or more region divisions belong.

[0025]<u>Drawing 2</u> shows the variable length coding device of the 2nd example of this invention. Identical codes are given to the same function part as the 1st example. In the case of this examplethe quantization DCT coefficient inputted into the input edge 11A zigzag scan is carried out from low-pass [of a DCT coefficient field] with the scan converter 12 in a high regionand the data of the quantization DCT coefficient is first inputted into a zero run length / non-zero coefficient primary detecting element 22and is first changed into the series of the combination (LM) of a zero run length and non-zero coefficient amplitude. The series of this combination is inputted into the coefficient count circuits 20 and the switching circuit 13and is divided and inputted into the two-dimensional Huffman table reference parts 1718and 19 corresponding to two or more conversion factor fields divided according to DCT coefficient distribution of a picture signal in the switching circuit 13. And a change output is carried out one by one from low-pass [the] in a high region. In the coefficient count circuits 108if the sum of (L+1) is calculated whenever the combination of (LM) inputsthe number of the input conversion coefficient is counted and it becomes [whether this number is larger than the number of elements of each region divisionand] equalthe switching control signal to the next region division will be generated.

[0026]As shown in <u>drawing 7</u> (c) in the case of the 2nd examplewhen a zero run length straddles two or more region divisions (AB)the combination (52) of the zero run length and non-zero coefficient amplitude will be incorporated into the field (A) to which the first zero belongand two-dimensional Huffman encoding will be carried out. Thereforeas it said that even from (05) of the field A to (52) were first inputted into the two-dimensional Huffman table reference part 17and it inputted into the two-dimensional Huffman table reference part 18 as the field B after the next (21)it is outputted one by one. In a two-dimensional Huffman table reference partthe symbolic language

according to each field is assigned and outputted. As a resultthe coded DCT coefficient sequence will be too outputted to a high region one by one from low-pass [of a DCT coefficient field].

[0027]Drawing 3 is a variable length decoding device corresponding to coding of the 1st and 2nd examples of this invention. The picture coded by the input edge 31 of the variable length decoding device with the above-mentioned variable length coding device inputs into an 8x8-pixel block unit. This coded image (symbolic language) is the switching circuit 32and is again divided and outputted to three DCT coefficient fields corresponding to the field ABand C.

[0028]In the two-dimensional Huffman decoding table reference parts 3334and 35 respectively corresponding to the two-dimensional Huffman coding word table reference parts 1718and 19 of drawing 1 (or drawing 2)the divided symbolic-language sequence is reconverted and outputted to the series of the combination of a zero run length and non-zero coefficient amplitude. The series of the outputted combination is inputted into a zero run length / non-zero coefficient decoding part 36and the end primary detecting element 37 of division. In a zero run length / non-zero coefficient decoding part 36. The series output of the above-mentioned combination is reconverted one by one to the one-dimensional data row of the quantized DCT coefficient of the origin of ten pieces (field A)18 pieces (field B)and 36 pieces (field C)and it is outputted to a high region one by one from low-pass [of a DCT coefficient field] in order of the data of the field ABand C. As a resultthe output of a zero run length / non-zero coefficient decoding part 36 becomes the 64 original one-dimensional series by which the zigzag scan was carried out. And in the quantization data rearrangement circuit 3864 one-dimensional data rows are reconverted at the 8x8 original two-dimensional data. The algorithm shown in drawing 4 detects the end of each region divisionand the switching circuit 112 is controlled by the end primary detecting element 37 of a region division.

[0029]flow chart explanation of detection of the end of a region division performed in drawing 4 in the end primary detecting element 37 of a region division -- it carries out. In Step S1when the combination (LM) of a zero run length and non-zero coefficient amplitude inputs every 8x8 picture element blockthe number is set to k= 1. If it counts from low-pass [of a DCT transformation field] and the total of the DCT coefficient of C (n) and its region division is set to M (n) for the number of inputs of the DCT coefficient in the n-th region division (n= 12--N)in Step S2C (n) will be first reset to zero. And when two-dimensional Huffman encoding is carried out also including the zero over two or more fields in the case of the example [1st]. At Step S3 to the step S6the number of the DCT coefficient is calculated from combining (LM)and it continues adding to the number of inputs of a DCT coefficient until the number of inputs of the DCT coefficient in a

region division becomes equal to the total of the DCT coefficient of a region division. That isthe number of this combination adds this to C (n) by step S4 for the zero run length+1 (a part for a non-zero coefficient). And if the number of inputs becomes equal to a total at lastit will switch so that a switch may be carried forward to the next region division at Step S7. The above step is repeated to the last region division. In the example of <u>drawing 8</u> (a)these steps are repeated until the number of inputs will be ten pieces in the field Aand the control signal which switches a switch to the two-dimensional Huffman decoding table of the field B is outputted. And this is similarly performed about 18 of the field Band 36 of the field C.

[0030]When the numerals (EOSB) which show the end of the combination in a region division like the 1st example are transmittedthis is compared at Step S3. What is necessary is just to make the judgment type of Step 3 into {C(n) <M(n) ?} in the case of the 2nd example.

[0031]As another division systemas shown in <u>drawing 8</u>the number of partitions of a DCT coefficient field is arbitrary to a maximum of 8x8=64 (piece). Howeversince a zero run length does not arise in 64 divisionthe Huffman coding based on the probability of occurrence of the coefficient amplitude which includes zero about each 64 region division will be applied.

[0032]Generallyif the number of partitions increasesthe increase in circuit structuresuch as ROM which stores a two-dimensional Huffman coding word tablewill be expectedbut. Since the average code length of two-dimensional Huffman assigned to each region division can expect to become short if the number of partitions increasescircuit structure does not necessarily increase in proportion to the increase in the number of partitions.

[0033]As another division systemthe following methods are also possible further again according to the scanning direction at the time of scanning conversion. If it scans in order in a high region from low-pass [of a DCT coefficient field] according to DCT coefficient distribution of a picture signal in the case of scanning conversionit is also possible to perform a scan as shown in <u>drawing 8</u> (c) and (d) in addition to an old zigzag scanit can divide into two or more fields also in this caseand this method can be applied. Improvement in encoding efficiency can be aimed at with the bias of DCT coefficient distribution of an input picture signal by changing a scan. <u>Drawing 5</u> (A) shows the example of another coding equipment.

[0034]For examplewhen coding equipment gives two or more scanning order and quantization characteristics and it has come to be able to carry out the adaptation of itadaptation of the set of the two-dimensional Huffman coding word table corresponding to them is prepared and carried out. Herethe case where it has the quantization characteristic of M pieces is explained hereafter.

[0035]The picture signal divided every 8x8 picture element block is scanned by DCT and the scanning order which was quantizedinputted into the input edge 41 and was chosen from low-pass [of a DCT coefficient field] with the scan converter 42 in the high region. This data is inputted into a zero run length / non-zero coefficient primary detecting element 43and is first changed into the series of the combination of a zero run length and non-zero coefficient amplitude. The series of this combination is switched and outputted to either of the table settings 4546and 47 of M two-dimensional Huffman coding words corresponding to the quantization characteristic of having been used in the switching circuit 44 by the switching control signal (given from the terminal 49) which shows change of the quantization characteristic. And inside each table settings 4546and 47the same processing as the case where Example 1 or 2 explains as shown in the figure (B) is performed. Namelythe series of combination is divided into the two-dimensional Huffman table reference parts 1718and 19 corresponding to two or more conversion factor fields divided according to DCT coefficient distribution of a picture signal in the switching circuit 13and a change output is carried out one by one from low-pass [the] in a high regionIn a two-dimensional Huffman table reference partthe symbolic language according to each field is assigned and outputted.

[0036]Drawing 6 (A) is a decoding device corresponding to the above-mentioned coding equipment. The picture coded by the input edge 51 with the above-mentioned variable length coding device inputs into an 8x8-pixel block unit. This coded image is the switching circuit 52and is outputted to the table settings 5354and 55 of M two-dimensional Huffman decoding tables corresponding to adaptation of the quantization characteristic. Based on the control signal given from the terminal 49switching control of the switching circuit 52 is carried out. Inside a 2-dimensional each Huffman decoding table setting (shown in the figure (B))the same operation as the circuit of drawing 3 is performedand the series of the combination of a zero run length and non-zero coefficient amplitude is outputted. And in a zero run length / non-zero coefficient decoding part 56the series output of the above-mentioned combination is reconverted to the one-dimensional data row of the quantized original DCT coefficientand it is outputted to a high region one by one from low-pass [of a DCT coefficient field]. And in the quantization data rearrangement circuit 5764 one-dimensional TETA sequences are reconverted and outputted to the 8x8 original two-dimensional data. As a resultthe set of the two-dimensional Huffman table corresponding to the character of various input picture signals can be switched accommodativeand improvement in much more encoding efficiency can be aimed at.

[0037]Abovein the case of DCT processing of a NxN picture element blockalthough the example in DCT processing of 8x8 picture element block was

describedit is generally applicable similarly. Each of these is contained in the generic claim of this invention.

[0038]

[Effect of the Invention]DCT coefficient distribution of the signal which should be processed according to this invention as explained above -- ohimprovement in encoding efficiency can be aimed at by dividing a DCT coefficient fieldand performing and carrying out variable length coding of the symbolic-language assignment by each optimal two-dimensional Huffman encoding paying attention to the character concentrated on ******.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1]The block diagram showing the example of the coding equipment concerning this invention.

[Drawing 2]The block diagram showing other same examples of coding equipment.

[Drawing 3]The block diagram showing the example of the decoding device concerning this invention.

[Drawing 4]The flow chart shown in order to explain operation of the end primary detecting element of a region division of drawing 3.

[Drawing 5]The block diagram showing other examples of the coding equipment concerning this invention.

[Drawing 6]The block diagram showing other examples of the decoding device concerning this invention.

[Drawing 7]The explanatory view showing an example in case a zero run length straddles two or more region divisions.

[Drawing 8]The explanatory view showing the example of division of a block of a quantization DCT coefficient.

[Drawing 9]The explanatory view of the conventional encoding processor.

[Drawing 10]The explanatory view of the conventional decoding processing device.

[Drawing 11]A DCT coefficient and the explanatory view of scanning order.

[Drawing 12]The figure showing the example of a two-dimensional Huffman coding word table.

[Drawing 13]The distribution explanatory view of the DCT coefficient in a picture signal.

[Description of Notations]

12 -- A scan converter13 -- A switching circuit14-1622 -- A zero run length / non-zero coefficient primary detecting element17-19 [-- A two-dimensional Huffman decoding table reference part36 / -- A zero run length / non-zero

coefficient decoding part37 / -- The end primary detecting element of a region division38 / -- Quantization data rearrangement circuit.] -- A two-dimensional Huffman table reference part20 -- Coefficient count circuits32 -- A switching circuit33-35